APPENDIX NOT INCLUDED

SAMPLING AND ANALYSIS PLAN - VOLUME I
FIELD SAMPLING PLAN

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. On July 27, 2005, the EPA issued a modified Unilateral Administrative Order (UAO), requiring the potentially responsible parties to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. This Field Sampling Plan (FSP) has been prepared as Volume I of a Sampling and Analysis Plan (SAP) in accordance with Paragraph 27.a of the Statement of Work (SOW) for the RI/FS included as an Attachment to the UAO. The FSP has been prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow) (collectively referred to as Respondents in the UAO).

The FSP format and elements have been developed in accordance with guidance developed by the United States Environmental Protection Agency (EPA, 1988). The plan presents specific sampling locations, equipment and procedures to be used during the RI/FS. A general description of RI/FS activities is provided in the RI/FS Work Plan (PBW, 2006a). Quality assurance/quality control (QA/QC) policies, organization, objectives, functional activities, and other specific QA/QC activities are described in Volume II of the SAP, the Quality Assurance Project Plan (QAPP) (PBW, 2006b).

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

The Site is located about three miles northeast of Freeport, Texas in Brazoria County at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west.

The Site is located between Galveston and Matagorda Bays and is situated along approximately 1,200 feet of shoreline on the Intracoastal Waterway. The Intracoastal Waterway is a coastal shipping canal that extends from Port Isabel to West Orange on the Texas Gulf Coast.

Marlin Avenue divides the Site into two areas (Figure 2). For the purposes of this work plan, it is assumed that Marlin Avenue runs due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and the closed impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses and will continue to be used for commercial/industrial purposes in the future. Adjacent property to the north, west and east of the northern portion of the Site is unused and undeveloped. Adjacent property to the east of the southern portion of the Site is developed and currently used for industrial purposes while to the west the property is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south.

The South Area includes approximately 20 acres of upland that was created from dredged material from the construction of the Intracoastal Waterway. Some of the North Area is upland created from dredge spoil, while most of this area is considered wetlands (RI/FS Work Plan, Figure 3 (PBW, 2006a)). The wetlands on and north of the Site are estuarine, intertidal, emergent, persistent, and irregularly flooded.

The Intracoastal Waterway supports barge traffic and other boating activities. The area near the Site is regularly dredged and, as noted by the United States Fish and Wildlife Service (USFWS), shoreline habitat is limited (USFWS, 2005).

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The Site geology consists predominantly of Quaternary alluvium and “fill and spoil” from the construction of the Intracoastal Waterway (Barnes, 1987), as shown on Figure 3. The alluvium consists of clay, silt, sand and gravel, with organic material abundant in the soils. The fill and spoil material consist of dredged material “for raising land surface above alluvium and barrier island deposits and creating land” (Barnes, 1987). The spoil material is highly variable with mixed mud, silt, sand and shell, with the reworked spoil mostly sandy and moderately sorted (McGowen, 1976).

Underlying the alluvium unit is the Beaumont Formation, which consists of clayey soils with interconnected, alluvial sand channels and barrier island beach deposits encountered in the formation. The Beaumont Formation is about 100 feet thick. The Lissie and Willis Formations underlie the Beaumont Formation. The Lissie Formation consists of interbedded sands, silts, and clays and is about 200 feet thick, overlying the Willis Formation, which consists of gravel, sand silt, and clay. The Alta Loma Sand is part of the Willis Formation and is the thickest sand sequence in the Willis Formation. The base of the Alta Loma Sand in southeast Brazoria County is about 1,200 feet below mean sea level (MSL) (Sandeen, 1982).

The two primary hydrogeologic units beneath the Site are the Chicot and Evangeline Aquifers. The Chicot consists of the Willis, Lissie, and Beaumont Formations. The Evangeline Aquifer consists of sands of the Goliad and Fleming Formations. The Chicot Aquifer is subdivided into two zones: the Lower and Upper Chicot. The Lower Chicot in Brazoria County generally includes the Alta Loma Sand unit, which is about 400 feet thick in the Freeport area (Sandeen, 1987). The Upper Chicot is made up of interconnected sands that are found within 300 feet below ground surface.

The main source of groundwater in the area is from the Chicot Aquifer. The Lower Chicot can produce as much as 3,000 gallons per minute (gpm); however the water contains a large amount of slightly saline water (1,000 to 3,000 mg/L total dissolved solids (TDS)). The Upper Chicot is the most-widespread fresh-water aquifer in Brazoria County, and wells completed in Upper Chicot sands at least 50 feet thick can yield 500 to 1,000 gpm. However, in some areas along the coast the interbedding of saline water with fresh water has been encountered (Sandeen, 1987).

The Site and vicinity currently receive water via pipeline from the City of Freeport. During the early operation at the Site, water was supplied for barge cleaning operations by two on-site water wells. It was reported that one of these wells was located adjacent to the front entrance gate south of Marlin Avenue (TNRCC, 2000b); however, neither of these wells could be located in July 2005.

The closest water well (TWDB ID 81-06-303) identified near the Site is located on the adjacent property west of the Site at a former marina. The total depth of the well is reported to be 199 feet below ground surface. Water quality from the well in 1969 showed a TDS concentration of 1,382 mg/L with the depth to water about 67 feet (TWDB, 2005). In July 2005 this well was observed to be present, but was abandoned with the drop pipe unsecured.

The previous monitoring wells installed at the Site were installed in shallow water-bearing sands less than 50 feet below ground surface. Three monitoring wells, HMW-1, HMW-2, and HMW-3 (Figure 2) that were installed in January 1989 were completed in a sand unit about nine feet thick, with the top of the sand encountered about nine feet below ground surface (Hercules, 1989).

2.3 POTENTIAL SOURCE AREAS (PSAs)

As detailed in Section 3.2 of the RI/FS Work Plan, 13 Potential Source Areas (PSAs) have been identified at the Site based on the Site operations history, previous investigations and existing data as described in the RI/FS Work Plan. These PSAs are listed below and shown on Figure 4.

Former Aboveground Storage Tank (AST) Tank Farm Area	Sand Blasting Areas	Former Product Storage Tank Area
Pipelines	Welding Area	Former Gasoline Storage Tank Area
Former Surface Impoundment Area	Dry Dock Area	Lot 21 Area
Former Wash Water Storage Tank Area	Surface Drainage Areas	
Electrical Shed	Former Septic Tank Areas	

2.4 CONCEPTUAL SITE MODEL

As detailed in the RI/FS Work Plan Section 3.3, preliminary Conceptual Site Models (CSMs) were developed for both human health and ecological receptors for the Site. Using the CSMs, a list of site-wide chemicals of interest (COIs) was developed from the RI/FS Work Plan based on Site historical information regarding chemicals potentially used or handled at the Site, existing Site data, and discussions with EPA during the scoping phase meeting for this Site. As such, COIs for the Site generally include metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). It should be noted that the term COI has been used to indicate, in most PSAs, the full suite of analytes.

Based on an evaluation of the potentially complete pathways identified in the RI/FS Work Plan CSMs, and an analyses of the information needed to assess the completeness of these pathways, data needs were identified to satisfy the objectives of the RI/FS and to establish the objectives set forth in this FSP.

3.0 SAMPLING PLAN

As described in the RI/FS WP, the overall objective to be addressed by the RI/FS is to evaluate the nature and extent of contamination at and from the Site, assess the risk from this contamination to human health and the environment, and evaluate potential remedial alternatives. The technical approach for meeting these objectives is described in detail in the RI/FS Work Plan. The objective of the RI/FS FSP is to define in detail the sampling and data gathering methods needed to obtain data that are representative of site conditions and will be used to define the nature and extent of contamination and provide input to the risk assessment.

Based on the Data Quality Objectives (DQOs) detailed in the QAPP, the sampling plan design for the RI/FS consists of both judgmental and systematic sampling to satisfy the project objective of defining the nature and extent of contamination. The samples per media required for this investigation are summarized in the Sample Design Collection Worksheet (Table 1). The worksheet contains the elements needed to support the decisions for RI sampling design to meet data requirements for the risk assessment.

The field activities detailed in this FSP will be conducted in a general phased approach as discussed for each media in the section below. The proposed sample locations detailed in this FSP are initial locations that may be modified based on field conditions. Additional samples may be needed for nature and extent based on the initial data obtained.

3.1 LOCATING PROPOSED SAMPLE STATIONS

Sample stations will be located in the field using the coordinates extrapolated from locations on the Site maps (Figure 5 for the North Area and Figure 6 for South Area). A differential global positioning satellite (GPS) receiver will be used to locate the proposed sampling sites in the field. The GPS unit will utilize real-time corrections to achieve the horizontal and vertical coordinates with sub-meter accuracy. Accuracy of the sample locations is important to mapping analytical results, so a relatively high degree of confidence is needed as to where each sample is collected, and if needed, the sample location can be reacquired for future efforts. The desired coordinates will be programmed into the GPS and the receiver can then guide the user to the desired coordinates. However, the proposed sampling locations may be modified in the field based on field conditions and professional judgment.

3.2 FORMER SURFACE IMPOUNDMENT CAP EVALUATION

The objective of this evaluation is to assess the construction materials and thickness of the caps constructed on the former surface impoundments in order to evaluate the potential for transport of VOCs as discussed in the RI/FS Work Plan. The following activities shall be performed as part of this evaluation:

- Advance four soil borings within the former surface impoundments for a geotechnical evaluation, as shown on Figure 5. Borings will be drilled and continuously sampled to a depth of five feet or to the base of the cap material, whichever occurs first, as detailed in Section 5.4.3.

- Collect one representative soil sample from each boring for laboratory geotechnical analyses detailed on Table 2 (Percent Passing No. 200 Sieve, Atterburg Limits, and vertical hydraulic conductivity).

- Perform a field inspection of the cap area, including observation of desiccation cracks, erosion features and overall surface condition. The inspection will be documented following the field document procedures detailed in Section 6.3.

3.3 SURFACE GEOPHYSICS EVALUATION

The objective of this evaluation is to attempt to locate former pipelines at the Site that may have been used to transport product material or wash water associated with the barge cleaning process from the barges and former AST tank farm area to the former surface impoundments or the wash water storage area. An electromagnetic (EM) metal detector, Geonics EM-61 or equivalent meter, and an EM radiodetection (RD) meter will be used to record magnetic anomalies caused by buried metal. Transects will be surveyed across the PSAs as shown on Figure 7. Two areas have been identified for conducting the EM surveys:

- Pipeline corridor for pipeline from AST Area to Former Surface Impoundment Area; and

- Pipeline corridor between AST Area and Former Wash Water Tank Area.

Before conducting the EM-61 survey, the RD meter will be used to identify potential buried pipes. The EM-61 MK2 meter will be used to support the RD meter data and to survey larger areas. The EM-61 MK2 transects for the pipeline areas will be oriented perpendicular to the assumed pipeline layout. As an example, the pipeline that was believed to transport wash water from the barge cleaning process to the Former Surface Impoundment Area likely was oriented north-south. Therefore, the EM transects will be oriented east-west. The spacing of the EM transects for the pipeline surveys will be about 50 feet with readings collected approximately every 5 feet. Transects will be surveyed in the field using the GPS meter by recording northing and easting coordinates. If any anomalies are identified in the field, additional transects may be added to further identify and delineate the anomalies.

3.4 SOIL INVESTIGATION

The objective of the soil investigation is to evaluate the lateral and vertical extent of COIs in soils as detailed in the RI/FS Work Plan. Soil samples will be collected following the sampling procedures detailed in Section 5.4.

For the initial phase of the investigation, the following four sets of soil samples will be collected as part of this investigation**:**

- PSA-based soil sample locations;
- Random systematic grid-based soil sample locations;
- Residential surface soil investigation samples; and
- Soil fate and transport characterization samples.

In addition, background soil samples may also be collected if needed.

3.4.1 PSA-Based Samples

Soil samples will be collected at each PSA listed in Section 2.3 using both judgmental and random systematic grid-based locations. The proposed soil sample locations within each PSA are presented on Figures 5 and 6 and the total number of sampling stations and samples in each PSA are summarized in Table 2. At each soil sample location, samples will be collected from the following intervals:

- 0 to 6 inch and
- 12 to 24 inch depth intervals.

Soil samples will be analyzed for the analytical suites presented on Table 2. Should any COIs in a soil sample from the 12 to 24 inch depth interval exceed their respective Preliminary Screening Values (PSVs) as detailed in the RI/FS Work Plan, then additional deeper soil samples will be collected as needed to define the vertical extent of that COI, but not to a depth below the water table or 5 feet below ground surface.

The proposed judgmental-based sample locations within the PSAs were selected using existing data or by identifying locations within the PSA where the potential for a release may be more likely (e.g., near the sump within the former AST tank farm area). The locations of the actual judgment-based sample stations may be adjusted based on field observations and professional judgment (e.g., an observed seep area below the former AST tank farm containment wall).

3.4.2 Random Systematic Grid-Based Soil Sample Locations

For any areas within a grid that are not sampled as part of the PSA sampling program described above, random systematic grid-based soil samples will be collected on a 200-foot grid spacing in the North Area (Figure 5) and on a 100-foot grid spacing in the South Area (Figure 6). Soil samples will not be collected from grid-based locations falling within the wetland areas (shown on Figure 3 of the RI/FS Work Plan) or obviously observed to be wetland areas during sampling. Rather, sediment samples will be collected from those locations as described in Section 3.8, below. At each soil sample location, samples will be collected from the following intervals:

- 0 to 6 inch and
- 12 to 24 inch depth intervals.

Soil samples will be analyzed for the analytical suites presented on Table 2. Should any COIs in a soil sample from the 12 to 24 inch depth interval exceed their respective PSVs as detailed in the RI/FS Work Plan, then additional deeper soil samples will be collected as needed to define the vertical extent of that COI, but not to a depth below the water table or 5 feet below ground surface.

3.4.3 Background Soil Samples

Should background soil samples be needed for the PSV comparisons described in the RI/FS Work Plan, nine background soil samples will be collected on a grid spacing within the background soil sample area shown on Figure 8, with the condition that visibly disturbed areas associated with other industrial operations will not be sampled. These samples will be collected from the 0 to 6 inch depth interval and will be analyzed for the specific analytes for which a background characterization is needed.

3.4.4 Residential Surface Soil Investigation Samples

As part of the residential surface soil investigation program described in the RI/FS Work Plan, samples will be collected from the 0 to 1 inch depth interval at 3 judgment-based locations in the Lot 21 sand blasting area, 7 judgment-based locations along the western boundary of Lot 21 at the Site where a dust screen was formerly located, and 27 random locations within a 100-foot sample block grid on off-site Lots 19 and 20 (Figure 9). In addition, samples shall also be collected from the 0 to 1 inch depth interval on the seven residential properties on the west side of Snapper Lane, subject to acquisition of appropriate access agreements. For these residential properties, a five-point composite sample will be collected from the front yard of the property, a five-point composite sample will be collected from the back yard, and a four-point composite sample will be collected from the drip zone near the mid-point of each side of the residence on the property (for those properties containing a residence) in accordance with guidance in the EPA Superfund Lead-Contaminated Residential Sites Handbook (EPA, 2003). Composite samples will also be collected from any distinct play areas and gardens present on the residential properties to be sampled.

The residential surface soil investigation program will be performed in several steps. After analytical data from surface soil samples from Lot 21 have been obtained, samples will be collected from Lots 19 and 20 with the analyte list for these samples developed based on the PSV comparisons for the Lots 21, 22 and 23 sample data described in the RI/FS Work Plan. Samples will then be collected from the residential properties on the west side of Snapper Lane with the analyte list for these samples developed based on PSV comparisons to the Lot 19 and 20 samples. If there are no PSV and background exceedences in a given step, then the subsequent step would not be performed. Additional residential properties will be sampled if data from any of the residential properties on the west side of Snapper Lane exceed the PSVs and background and the exceedence is attributable to the Gulfco site.

3.4.5 Soil Fate and Transport Characterization Samples

In addition to the COI analyses described above, three representative soil samples from the North Area and three representative soil samples from the South Area (to be selected based on field observations) will be analyzed for bulk density, specific gravity, fraction organic carbon (foc), and pH to support evaluations of contaminant fate and transport. These samples will be collected from the 12-inch to 24-inch sample interval at a location where no visual evidence of contamination is observed.

3.5 WATER WELL SURVEY

The objective of this task is to provide supporting information for evaluating the potential for contaminant migration to water supply wells, as detailed in the RI/FS Work Plan. The following activities shall be performed during this phase of the investigation:

- An updated search of Texas Water Development Board (TWDB) and TCEQ records for all registered water wells located within ½-mile radius of the Site boundary will be performed.
- After the records search has been conducted, a field survey to confirm/update information obtained during the records search will be performed and attempts will be made to identify any unregistered water supply wells located within ½-mile radius of the Site boundary.

3.6 GROUNDWATER INVESTIGATION

The objective of the groundwater investigation is to evaluate the lateral and vertical extent of potential non-aqueous phase liquids (NAPLs) and COIs in groundwater as detailed in the RI/FS Work Plan. The following activities shall be performed as part of this investigation:

- Installation and development of 17 permanent groundwater monitoring wells in the vicinity of Site PSAs as shown on Figures 5 and 6 and listed below:

  a. Former AST Tank Farm Area – three monitoring wells around the containment area, with one well between this area and the adjacent barge slip (Figure 6);

b. Pipelines – one monitoring well along path of pipeline from former AST Tank Farm Area to former surface impoundments (Figure 5), and one monitoring well between the former AST Tank Farm and the Intracoastal Waterway (Figure 6);

c. Former Surface Impoundment Area – four monitoring wells on impoundment perimeter (Figure 5);

d. Former Wash Water Storage Tank Area – one monitoring well on the south end of this area near the Intracoastal Waterway (Figure 6);

e. Sand Blast Areas – one monitoring well at each of the two sand blast areas, with one of the wells near the nearby barge slip (Figure 6);

f. Welding Area – one monitoring well on the south end of this area near the Intracoastal Waterway (Figure 6);

g. Surface Drainage Areas – one monitoring well in the east surface drainage area, near the Intracoastal Waterway (Figure 6);

h. Former Septic Tank Areas – one monitoring well at each of the two former septic tank areas (Figure 6); and

i. Former Product Storage Tank Area – one monitoring well (Figure 5).

These PSA-based wells include four locations immediately northwest of the Intracoastal Waterway and two near the Site barge slips that will provide an indication of groundwater conditions near likely points of discharge to surface water.

- Temporary piezometers will be installed at two locations southwest of the former surface impoundment area (Figure 5), four locations on the former impoundment perimeter (Figure 5), one location southwest of the former Dry Dock (Figure 6), and one location south of the western former Septic Tank Area (Figure 6).

- Two staff gauges will be installed at the Site; one in the wetlands in the North Area (Figure 5) and a second gauge along the shore of the Intracoastal Waterway (Figure 6). The proposed locations for the staff gauges are subject to modification based on field conditions.

Monitoring well locations may be modified in the field based on accessibility constraints or field observations. Details of the monitoring well and temporary piezometer installation, development, water level measurements (including NAPL measurements), and groundwater sampling are presented in Section 5.5. Groundwater samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures detailed in Section 5.5.2. Groundwater samples will be analyzed for the suite of analyses listed in Table 2.

The monitoring well and staff gauge locations will be surveyed by a licensed surveyor to Texas State Plane Coordinates. Top of casing elevations and staff gauge measurement points will be surveyed relative to mean sea level (MSL). In order to evaluate groundwater flow rates and directions, Site water level data with the well and staff gauge survey data will be used to construct potentiometric surface maps for the Site. In addition, the staff gauge readings will be used to correlate the surface water elevations with the groundwater elevations.

3.6.1 Hydraulic Testing

Wells for hydraulic testing will be selected based on lithologic data, water level measurements, and drawdown/recharge behavior during development and sampling. The goal is to select wells that represent the range of hydraulic conditions in the water-bearing unit to be evaluated. Hydraulic testing and associated data analysis procedures are detailed in the Section 5.5.3.

3.6.2 NAPL Delineation

The objective of this task, if proven necessary from the initial groundwater investigation, will be to define the lateral extent of NAPL in the affected water-bearing unit. A combination of direct push methods, auger drilled soil borings, and/or monitoring wells may be used in this effort. The lateral extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well. Any NAPL field screening techniques used in this effort will be subject to Demonstration of Method Applicability (DMA), which will be submitted to the EPA for review and approval following the initial monitoring well installation.

If the presence of NAPL is identified in any of the monitoring wells installed, the following actions will be taken:

- Attempts will be made to collect a sample of the NAPL from each well in which it is observed. NAPL samples will be analyzed for specific gravity, VOCs, SVOCs and pesticides as presented on Table 2.

- The use of possible field screening methods to evaluate NAPL presence will be evaluated following the initial monitoring installation. If a promising candidate method is identified, a pilot test of the method will be performed, and depending on the pilot test results, a DMA will be prepared.

- The vertical extent of NAPL will be defined by advancing deeper borings (using direct push or auger methods) or installing deeper monitoring wells outside the perimeter of the identified NAPL zone to the base of the next underlying water-bearing unit, or within the NAPL zone if a surface isolation casing is used and a competent underlying confining unit is identified. The vertical extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well.

- Additional soil borings will be drilled to delineate the lateral extent of NAPL in the water-bearing zone(s).

3.6.3 Additional Groundwater Delineation

Should any groundwater sample locations at the perimeter of the Site exceed the PSVs, as detailed in the RI/FS Work Plan, then additional lateral groundwater delineation sampling will be conducted by using reconnaissance field methods (i.e., temporary piezometers). Additional vertical delineation will be conducted by collecting at least three groundwater samples from the next water-bearing zone below the affected water-bearing zone. These samples may be collected from permanent monitoring wells or temporary piezometers. It is likely that a surface or isolation casing may be installed prior to placement of the deeper well or piezometer. Hydraulic testing, as described in Section 3.6.1, will be performed for all affected water-bearing units.

3.6.4 Deep Lithologic Boring

In response to EPA requests, the subsurface stratigraphy from the ground surface to the top of the uppermost water supply aquifer will be evaluated through advancement of a mud-rotary pilot boring to an approximate depth of 200 feet. The location will be selected following delineation of the lateral extent of COIs exceeding PSVs to ensure the boring is not drilled in an area where Site contaminants might migrate to deeper water-bearing units. The pilot boring will be geophysically logged for the following geophysical logging signatures:

a. Spontaneous Potential (SP);

b. Resistivity (single point, short and long normal); and

c. Natural gamma.

The geophysical log signatures will be compared to the drill cuttings to correlate the lithology to the geophysical signatures. Details of the pilot hole drilling, geophysical logging, and abandonment procedures are provided in Section 5.6.

3.7 SURFACE WATER INVESTIGATION

The objective of this task is to evaluate the lateral extent of potential COIs in surface water to evaluate potential human health and ecological risks listed in the RI/FS Work Plan. The following activities shall be performed as part of this investigation:

- On-Site Pond Sampling: The following surface water samples will be collected from each of the two ponds north of Marlin Avenue (Figure 5):

    - Three surface water samples will be collected from the Fresh Water Pond; and

    - Three samples will be collected from the Small Pond southeast of the Fresh Water Pond.

  The surface water samples will correspond with the pond sediment sampling locations discussed in Section 3.8 below.

- Intracoastal Waterway (ICWW) Sampling: One composite surface water sample will be collected from each of the four zones within the ICWW adjacent to the site as shown on Figure 10. Each composite will consist of three sub-samples. One sub-sample will be collected from approximately one foot below the water surface, the second sub-sample will be collected from mid-depth of the water column, and the third sub-sample will be collected from approximately one foot above the base of the water column.

- Wetlands Area Sampling: Surface water samples will be collected from 15 locations within the wetlands north of Marlin Avenue (including both on-site and off-site locations). The area that will be sampled is shown on Figure 11. These sample locations will be selected in the field based on drainage features and field observations.

- Background Sampling: Four composite background surface water samples will be collected from the background surface water sampling area shown on Figure 12. These composite samples will be collected in the same manner as the ICWW samples.

The surface water samples will be tested for the suite of analyses as presented on Table 2. Filtered and unfiltered samples will be collected for metals analyses. Sample collection procedures are specified in Section 5.7.

3.8 SEDIMENT INVESTIGATION

The objective of this investigation is to evaluate the lateral extent of COIs in sediments to evaluate potential human health and ecological risks listed as detailed in the RI/FS Work Plan. Sediment samples will be collected from the 0 to 6-inch depth interval at all locations. Deeper sediment samples will be collected from the 12 to 24-inch depth interval at any locations in the North Area where, based on field observations, dry conditions at this depth are indicated. Sediment samples will be analyzed for the analytical suites listed on Table 2.

The following areas will be sampled during this phase of the investigation:

- Fourteen sediment samples will be collected using the random systematic method on a 200-ft grid within the wetland areas in the North Area. Proposed locations are presented on Figure 5; however, locations may be modified based on field observations.

- Five sediment samples will be collected within the Fresh Water Pond on Lot 55 of the Site (Figure 5).

- Three sediment samples will be collected from the small pond to the southeast of the Fresh Water Pond, (Figure 5).

- Sediment samples will be collected from 15 off-site locations within the wetlands north and east of the Site. The general area from where samples will be collected is shown on Figure 11. These sample locations will be selected at the time of sampling based on drainage features and field observations.

- Sediment samples will be collected from the Barge Slips and Intracoastal Waterway as shown on Figure 10 and detailed below:

    - Barge Slip 1 (western barge slip) – five locations;

    - Barge Slip 2 (eastern barge slip) – five locations;

    - Intracoastal Waterway – six locations; and

    - Background – nine locations (background area shown on Figure 12).

Sediment samples will be collected using the procedures outlined in Section 5.8.

3.9 FISH TISSUE SAMPLING

Using the sediment data collected from the Intracoastal Waterway, the COIs for the fish tissue sampling will be established as detailed in the RI/FS Work Plan. The tissue from the following target fish (*species*) will be analyzed:

- red drum (*Sciaenops ocellatus*),
- spotted seatrout (*Cynoscion nebulosus*),
- southern flounder (*Paralichthys lethostigma*), and
- blue crabs (*Callinectes sapidus*).

If a sufficient number of specimens of the target species can not be collected at the Site during the sampling event, the following fish will serve as alternate species:

- Atlantic croaker (*Micropogonias undulates*);
- sheepshead (*Archosargus probatocephalus*), and/or
- black drum (*Pogonias cromis*)

No alternate shellfish species is proposed.

Finfish specimens will be collected using a combination of gill nets and baited hooks. Two sizes of gill net mesh will probably be used during the study (5 and 2 ¾ inch stretch mesh). Gill nets will be set at stations within four zones, as shown in Figure 10. Multiple nets and traps will be set in each sampling zone to ensure that a sufficient number of specimens of each species are collected in a short period of time. If composite samples are necessary, only tissue collected within a single zone will be composited. A total of 9 samples from each of the four target species (a total of 36 samples) will be collected and processed for analysis. One field duplicate will be processed for each species.

Background finfish/crab samples will also be collected at the area shown on Figure 12. Nine samples from each of the four species will be collected and sent to the laboratory. Laboratory analysis of the background samples will be conducted pending the results of the Site samples. The numbers of samples that are expected to be collected and analyzed are listed in Table 3. Fish tissue sampling procedures are presented in Section 5.9.

Since the objective of this study is to evaluate edible tissues, only fish and crabs that can be legally harvested by recreational or commercial fishermen will be collected. The size limits for each species will be based on Texas Parks and Wildlife size limits for recreational fishermen. Size limits for this study are listed in Table 3.

4.0 SAMPLE DESIGNATION

The station and sample numbering system for the project has been designed to uniquely identify each sampling station and sample according to the Site grid. This numbering system consists of grid column and row identification, sample media, a sequential sample location identifier, depth (if applicable), and QA/QC identifier (if applicable).

Two grid systems have been designed for the Site: a 200-foot grid for the North Area and a 100-foot grid for the South Area. The North Area grids will be assigned an “N” prefix and the South Area grids will be assigned an “S” prefix. Each column of each grid system will be assigned a letter (A, B, C…) and each row will be assigned a number (1, 2, 3…) as shown on Figures 5 and 6. Sediment and fish tissue samples collected from the Intracoastal Waterway will have an “IW” prefix and no grid designation.

Sample locations will be designated by sample type:

- soil boring (SB),
- monitoring well groundwater (MW),
- temporary piezometers (PZ),
- sediment (SE),
- surface water (SW)
- geotechnical (GT)
- surface soil (SS) or
- fish tissue and species (RD-red drum, ST-spotted seatrout, SF-southern flounder, BC-blue crab) (e.g., FTRD).

Following the sample type will be the sample location numbers. Generally, the samples for each media will be sequentially numbered, regardless if the sample station is a random or judgmental location. Depth intervals in feet below grade will be assigned to soil and sediment samples to designate the vertical sample location. As an example, the first sediment sample collected from 0 to 6 inches deep at a sample station north of Marlin Avenue at grid A1 for chemical analysis will be designated as follows:

- Sample ID: NA1SE-001-(0-6)

Field quality control samples such as matrix spikes and matrix spike duplicates and field duplicates, which are detailed in the QAPP, will be designated with the primary sample identification and a quality control suffix as noted below. Quality control samples for geotechnical analyses will not be collected.

Quality Control	Suffix Description	Sample Frequency
MS/MSD	Matrix spike/duplicate	1 per 20 samples per media
FD	Field duplicate	1 per 20 samples per media
EB	Equipment rinsate blank	1 per day/team
FB	Field blank	1 per day/team

5.0 SAMPLING EQUIPMENT AND PROCEDURES

5.1 FIELD EQUIPMENT

Various equipment will be used during the RI/FS field investigation. A partial list of possible equipment that will be used during the RI/FS are listed by investigation activity on Table 4. Additional equipment may be used as part of the RI depending if additional investigative techniques are necessary to achieve the project objectives.

At a minimum, field equipment will be cleaned, inspected, calibrated (if required), and tested prior to each day's use, or every month, whichever comes first. Equipment calibration guidelines are discussed in the QAPP, Section 3.8 (SAP Volume II). All equipment will be inspected visually and functionally by testing the equipment in accordance with the operator manual for each piece of equipment. Moving parts, seals, fasteners, and switches will be inspected and adjusted or replaced as necessary. All cables, tapes, and attachments will be inspected for damage or kinks. For equipment that requires standard solutions and buffers for calibration, those standards and buffers will be checked for expiration date and replaced if necessary. Preventative maintenance for the field equipment is discussed in the QAPP, Section 3.7 (SAP Volume II). The Field Supervisor is responsible for the proper functioning of field equipment.

5.2 LOCATING SAMPLING SITES

The proposed sample locations will be located in the field using the coordinates extrapolated from proposed sample locations on the Site maps. A differential GPS receiver, such as a Trimble GPS Pathfinder Pro XRS or equivalent, will be used to locate the proposed sampling sites in the field. Operation of the GPS receiver will follow the procedures detailed in the operation manual for the specific equipment.

Once a sample station is located according to the GPS coordinates, the station will be marked with a stake and brightly colored survey flagging material. If a sampling site is not accessible, an alternate location will be selected as near to the original point as practical. The alternate location will be marked with a stake, flagged, and the coordinates recorded. A utility locating service such as Texas One Call or Dig Tess will be contacted to check the proposed locations for the presence of buried utilities.

All sample stations will be marked in advance of sampling to minimize the collection of surface waters and sediments at sites where the area has been disturbed due to foot traffic. Navigation to a specific site will disturb the sediments in wetland areas, resulting in turbid surface water samples at those locations. Premarking the sample stations will aid in reducing this disturbance.

5.3 SURFACE GEOPHYSICAL SURVEY

As discussed in Section 3.3, a surface geophysics assessment using EM meters will be conducted to attempt to locate former pipelines at the Site. The assessment will be conducted with a Geonics EM-61 MK2 metal detector and an EM radiodetection (RD) meter.

The EM-61 MK2 is a time-domain metal detector which detects both ferrous and non-ferrous metals. A transmitter generates a pulsed primary magnetic field in the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil. By taking the measurement at a relatively long time after the start of the decay, the current induced in the ground has fully dissipated and only the current in the metal is still producing a secondary field. The responses are recorded and displayed by an integrated data logger (Geonics, 2005).

The RD meter, which operates similarly to the EM-61 MK2, detects the magnetic field created by alternating current flowing along a buried line. This alternating current creates a detectable magnetic field or signal because the current provides a magnetic field and an oscillating frequency of reversals. With both of these occurring, the pipe or line can be effectively located using the principles of electromagnetic induction. The RD meter can be operated in two modes: passive and active. The passive mode detects signals that are ‘naturally’ present. These signals can be produced by induction of electrical currents flowing from stray currents produced by power transmission systems and/or very low frequency long wave radio energy from distant transmitters. Active mode detection consists of applying an active signal directly to a line or by induction from a transmitter where the line can then be traced and located by the receiver (Radiodetection, 1994).

Both meters will be used in the field to identify and locate buried pipelines. The meters will be operated according to the operations manual for each meter.

5.4 SOIL INVESTIGATION METHODS

5.4.1 Soil Sampling

Shallow soil samples (0 to 2 feet bgs) may be collected using either plastic or stainless steel trowels, hand-auger, or by a split-spoon sampler driven by direct-push technology (DPT) techniques or a drill rig. Soil borings drilled with DPT will be advanced using a hydraulic ram or hammer to drive the soil samplers, and the soil samples may be collected using a butyrate-lined, split-spoon sampler. Soil borings that will be converted to monitoring wells may be drilled with hollow-stem auger methods and the borings for the temporary piezometers will be drilled using DPT methods. All sampling equipment will be decontaminated prior to and following each use, as detailed in Section 5.10.

Soil borings will be documented per PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A) using a detailed field lithologic log (Figure SOP-2-1). The lithology of the boring will be logged continuously for the total depth of each boring and soil samples will be collected. The method of sample collection and the sample collection interval will also be noted on the field lithologic log.

Soil samples collected at each location will be collected in accordance with the PBW SOP No. 5: Soil and Sediment Sampling for Chemical Analysis (Appendix A). For soil samples that will be analyzed for VOCs, samples will be collected using the SW-846 5035 Method by utilizing the EnCore® or equivalent sampling equipment. The 5035 Method procedures are detailed in PBW SOP No. 5. Field QA/QC procedures will be followed by collecting the necessary field duplicates and blanks as described in the QAPP Plan (Volume II).

For borings not converted to a monitoring well or a piezometer, the boring will be abandoned by filling the hole. If the boring is less than 2 feet deep, it can be filled with bentonite pellets. If the borehole is dry and is less than 10-feet deep, Portland/bentonite grout may be poured slowly from the ground surface into the borehole to the ground surface. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout should be placed in one continuous pour by pumping through a tremie hose or pipe. Specific procedures on plugging of borings are provided in PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A).

5.4.2 Field Screening

Soil samples from the monitoring wells and temporary piezometers will be collected and screened in the field for total organic vapor concentrations using an organic vapor meter (OVM)/photoionization detector (PID). Field screening will be conducted following the procedures detailed in the PBW SOP No. 3: Field Organic Vapor Screening Methodology for Soil Samples (Appendix A) and documented on the field lithologic log.

5.4.3 Impoundment Cap Sampling

Geotechnical soil samples may be obtained from the core using hollow-stem auger drill rig, direct push techniques (DPT), or from hand sampling devices. Soil samples to be analyzed for geotechnical analyses will be stored in sealed tubes or wrapped in aluminum foil and cellophane. Samples for moisture content must be sealed to preserve its natural moisture content. Undisturbed samples will be obtained with a thin-walled Shelby tube sampler and will be protected during shipping/transport. If materials are too consolidated and cannot be sampled with the Shelby tube, split spoon samples may be obtained and the sample will be wrapped in aluminum foil and plastic.

5.5 GROUNDWATER INVESTIGATION METHODS

The groundwater investigation will consist of installing and sampling groundwater from both permanent monitoring wells and temporary piezometers and conducting hydraulic testing on the uppermost water-bearing units at the Site. The equipment and procedures for these activities are discussed below.

5.5.1 Permanent and Temporary Well Installation

5.5.1.1 Permanent Monitoring Well Installation

Soil borings for monitoring wells will be advanced using hollow stem auger drilling methods. Soil samples will be collected continuously from each boring and will be logged in the field for lithology and sedimentary structure as described in Section 5.4. Soil headspace samples will be collected every two feet and screened in the field for total organic vapor concentrations. In addition, soil core samples will be visually inspected for NAPL presence. Soil cuttings generated from the drilling activities will be stored and disposed of following the procedures detailed in Section 7.0.

Soil borings that will be used for monitoring well installation will be advanced as necessary to identify the top and base of the uppermost water bearing-unit at the Site. Based on the boring logs for previous monitoring wells drilled at the Site, it is anticipated that these borings will be advanced to a maximum depth of 30 feet. If necessary, deeper borings will be advanced to underlying water-bearing units. Although these borings will be located away from areas where NAPL is present (if any), surface or isolation casing may be installed prior to penetration of any low permeability confining unit. In no case will a boring in which field indications of a NAPL are noted be advanced through an underlying low permeability confining unit.

Permanent monitoring wells will be constructed after the total depth of the borehole is reached. Monitoring wells will be constructed using 2-inch diameter, flush-joint-threaded Schedule 40 PVC casing and 0.010-inch slotted PVC screen. The specific well design will be determined in the field based on the observed lithology with the goal of screening the well at the base of the uppermost water-bearing unit. It is anticipated that each well screen will be approximately 10 to 15 feet in length and where possible will extend above the observed groundwater table. After the boring is completed to the total depth, the casing and screen will be lowered into the borehole through the augers.

Once the casing and screen are in place, the remaining well materials (filter sand, bentonite pellets, and cement/bentonite grout) will be added to the hole as the augers are slowly removed. Depths to the top of the annular materials will be measured with a weighted, calibrated tape and recorded on the Well Completion Log (Appendix A, Figure SOP-7-1). A bentonite seal layer will be installed on top of the filter sand and will be a minimum of 2 feet in thickness. The remainder of the borehole annulus will be filled with a Portland/bentonite grout (or bentonite pellets). Each well will be completed with either an at-grade surface completion with a 3-foot by 3-foot pad or above grade within a protective casing on a 4-foot-by-4-foot concrete pad. After construction, the position and elevation of each monitoring well will be surveyed relative to Texas State Plane Coordinates and mean sea level. Procedures for monitoring well installations are outlined in PBW SOP No. 7: Installation of Monitoring Wells and Piezometers (Appendix A).

A minimum of 24 hours shall elapse after well construction and before well development to allow for bentonite hydration and grout set. Development will consist initially of surging and bailing or pumping; however, the specific development method will ultimately be decided by the field personnel based on the specific conditions encountered. Temperature, pH, specific conductivity, and turbidity will be monitored during purging. Development will continue until the well produces water with stable field parameter readings (i.e., temperature, pH, conductivity) and turbidity is below 10 NTU. At least five casing volumes of water will be removed from the well during development. If the turbidity is not below 10 NTU after 10 casing volumes of water are removed from the well, then the final turbidity will be recorded and more aggressive development procedures such as air lifting may be considered. General procedures for monitoring well development are outlined in PBW SOP No. 8: Monitoring Well Development (Appendix A).

Documentation of well installation and development will include field boring logs, monitoring well installation forms, well development forms, and any photographs, as described in PBW SOP No. 1 Field Documentation (Appendix A).

5.5.1.2 Temporary Piezometer Installation

Temporary piezometers will be installed at selected locations as discussed in Section 3.6. Temporary piezometers may be installed using DPT methods, or similar methods. If the temporary piezometers are to be installed with DPT, the initial soil boring drilled to describe the lithology and soil field screening will be plugged and the temporary piezometer will be installed in a second boring no closer than 3 feet from the original soil boring to the target depth.

The piezometers may be constructed of small diameter (0.5 to 1-inch), flush-joint-threaded Schedule 40 PVC with a prepacked screen assembly and riser casing. A temporary surface seal will be placed in the borehole annulus to prevent surface water from traveling into the borehole after piezometer installation.

Each temporary piezometer will be developed, and purged and sampled relatively soon after installation. Development of the temporary piezometers will consist of pumping the piezometers at less than 1 liter per minute until the turbidity is less than 10 NTUs. If after 10 casing volumes are removed and the turbidity is still greater than 10 NTUs or if the temporary piezometers pumps dry, the Field Supervisor will decide if additional development is necessary depending on the field conditions and professional judgment.

The height of the PVC casing above the ground surface will be measured. Within 48 hours of installation, the temporary piezometer will be plugged and abandoned using the procedures detailed in PBW SOP No. 2 – Supervision of Exploratory Borings (Appendix A).

5.5.2 Groundwater Sampling

General procedures for groundwater sampling are outlined in PBW SOP No. 10: Water Quality Sampling (Appendix A). Groundwater samples will be collected from each of the monitoring wells no sooner than 24 hours after the completion of well development. Sampling of the temporary piezometers can be conducted shortly after installation and development. Before sampling, a complete set of water levels (including an evaluation of the possible presence of NAPL using an interface probe, conductivity probe and/or bailer) will be measured in all wells. In the event that NAPL is observed, an attempt will be made to collect a NAPL sample for possible future analysis.

Groundwater wells and piezometers will be purged and samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures. Purging will be accomplished in such a way as to minimize disturbance of sediments at the bottom of the well, and therefore minimize turbidity of the water samples. Typically, this is accomplished by purging at a low flow rate (less than one liter per minute) with the pump intake near the middle of the screened interval. If the yield of the well is low such that it can be pumped dry, then the recharged groundwater in the well will be considered representative of the formation groundwater, since all standing water in the well has been replaced by recharge from the water-yielding zone. Investigative-derived waste (IDW) (decontamination and purge water) will be placed and stored in drums at a designated staging area for off-site disposal, as detailed in Section 7.0.

Purging of the wells and piezometers will be accomplished by purging at a rate between 0.1 and 1 liters per minute while monitoring the following field parameters every 5 to 10 minutes: specific conductance, pH, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Procedures for taking ORP and DO measurements are detailed in PBW SOP No. 11:

Field Measurement of Oxidation-Reduction Potential (ORP) and PBW SOP No. 12: Field Measurement of Dissolved Oxygen (DO) (Appendix A). Meters will be calibrated before sampling each day, using the manufacturer's procedure. Odor and color of the purge water will also be noted. The field measurements will be recorded on the groundwater sampling record (Appendix A, Figure SOP-10-1).

Each monitoring well and piezometer will be purged until a minimum of five readings for the following parameters have been recorded and three consecutive readings have stabilized to within the following limits:

- specific conductance: +/- 10 percent
- pH: +/- 0.1 units
- temperature: +/- 1 degree Celsius
- turbidity: +/- 10 percent (or less than 10 NTUs)

After purging, groundwater samples will be collected from the discharge of the pump. If the stabilized turbidity reading is greater than 10 NTU, the discharge from the pump will be filtered with an in-line 10 μm filter. The in-line filter will be purged with approximately 200 mL of sample water before the laboratory container is filled. Filters and tubing will be used for only one sample and subsequently disposed.

Sample bottles will be prepared specifically for the required analyses by the analytical laboratory. Any required preservatives will be placed in the sample bottles by the laboratory prior to shipment to the Site. Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling. Field QA/QC procedures will be followed by collecting the necessary field duplicates and blanks, and samples will be handled, packaged, and transported as described in the QAPP (RI/FS SAP, Volume II (PBW, 2006b)).

Documentation will include groundwater sampling forms and any associated photographs.

5.5.3 Hydraulic/Slug Testing

Falling-head or rising-head tests ("slug tests") will be performed in the monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing strata. Slug tests will consist of instantaneously raising or lowering the water level in a well and then monitoring the change of the water level through time. The slug tests will be performed by rapidly submerging (slug-in test) or retracting (slug-out test) a slug of known volume. A typical slug used in two-inch wells is constructed of a sealed, one-inch diameter, PVC or stainless-steel pipe filled with sand. The displacement volume of the slug will be measured prior to the test program.

A pressure transducer or electric water line with an appropriate operating range may be used to measure the water levels during the slug tests. The pressure readings will be recorded and converted to feet of water above the transducer using a datalogger. The datalogger is programmed to record the water levels at one-second intervals at the beginning of a test and logarithmically increased to several minutes toward the end of the test. Upon arrival at each test well site, the static water level and total depth of the well will be measured with an electric water level interface probe. In the event NAPLs are encountered in the well, the hydraulic testing may be terminated. The pressure transducer will then be secured in the well to a depth below the lowest point to which the slug will be lowered. Before starting the test, sufficient time will be allowed for the water level in the well to adjust to the displacement caused by the transducer and cable, and for the transducer to equilibrate to the water temperature. During this period, the water level in the well will be monitored electronically using the datalogger and measured periodically with the electric water level probe to confirm that static water level conditions exist. Next, the slug will be lowered to a point just above the water level in the well and then rapidly submerged to begin the test. As data are collected, the water levels displayed by the datalogger will be examined to monitor trends and the progress of the test. Manual water level measurements also may be taken during the test to confirm the transducer readings.

Each test will proceed until the water level attains at least 90 percent recovery from the falling head test and rising head test. Following completion of the slug-in test, a rising-head or slug-out test will be performed by rapidly pulling the slug out of the water and monitoring the water level recovery in the same manner as for the slug-in test. In some cases, more than one slug-in and/or slug-out test may be performed to provide additional confirmation of the results.

The data collected by the datalogger are stored in the memory of the datalogger and then transferred to a computer in the field. When transferred to computer, the data sets are generally saved as comma-delineated ASCII format files. The contents of each data file are imported to a spreadsheet program that allows the data manipulation and graphical presentation needed to calculate the hydraulic parameters of the water-yielding zone. Slug test data will be analyzed by the methods discussed in PBW SOP No. 15: Hydraulic Testing (Appendix A).

5.6 DEEP BORING INSTALLATION AND GEOPHYSICAL LOGGING

Geophysical logging will be performed at one location in order to evaluate the subsurface lithology to the uppermost drinking water zone, estimated to be 200 feet below grade. The borehole will be drilled using wet-rotary drilling techniques and the drill cuttings will be described during the drilling operations. The soil boring will be documented per PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A) using a detailed field lithologic log (Appendix A, Figure SOP-2-1). The lithology of the boring will be logged continuously for the total depth of the boring. The lithologic description of the log should include soil or rock type, color, grain size, and other pertinent information, which will be noted on the field lithologic log.

After the borehole has been drilled to the desired depth, the borehole will remain filled with the drilling fluid to provide a conductive medium for running the geophysical logging tools. The test hole will be geophysically logged for the following geophysical logging signatures:

a. Spontaneous Potential (SP);

b. Resistivity (single point, short and long normal); and

c. Natural gamma.

The geophysical log signatures will be compared to the boring log (or cuttings) to correlate the lithology to the geophysical signatures. After the borehole has been logged, the hole will be plugged by placing one continuous pour by pumping through a tremie hose or pipe. Specific procedures on plugging of borings are provided in PBW SOP No. 2: Supervision of Exploratory Borings (Appendix A).

5.7 SURFACE WATER SAMPLING

When both sediment and surface water paired samples will be collected, the surface water samples will be collected prior to sampling of submerged sediments in order to reduce disturbance of the surface waters prior to their collection for chemical analyses. It is preferred that surface water samples be collected without entering the water or from a distance to minimize disturbance of sediments at the location where the surface water is to be collected. Within the wetland and pond areas, a single surface water sample is proposed for collection at each site (not including QA/QC samples collected at the frequency indicated in the QAPP). Composite depth samples will be collected from the ICWW locations as described in Section 3.7. Water depth will be recorded, and water chemistry parameters will be collected at all sample locations. These parameters will be collected using a multi-probe sonde that directly measures ambient:

- pH,
- conductivity,
- temperature,
- oxidation-reduction potential,
- salinity, and
- dissolved oxygen.

Surface water samples will be collected from the wetland and pond areas using either a dipping bucket on an extended pole or using a pole with attached peristaltic pump tubing to pump samples directly to the sample containers. The sample will be collected from the top quarter of the water column. Once sufficient water volume has been collected for each sample station, the sample will be placed into the respective sample containers for the analyses to be conducted. Surface water samples analyzed for metals will be collected in two samples: filtered and unfiltered. PBW SOP No. 10: Water Quality Sampling (Appendix A) provides details for the specific protocols for sampling of surface waters, including filtering procedures. The surface water sample stations will be surveyed using the differential GPS receiver, as detailed in Section 5.11.

Surface water sample stations within the ICWW will be located using a sub-meter Global Positioning System (GPS) and site coordinates will be recorded. Sampling will be performed using a custom 20 ft. aluminum flat bottom boat as the sample platform. Wherever possible, the sample platform will be positioned on station by tying off to shoreline structures to avoid using anchors that could disturb the sediment at the sample site. If anchors are required to stabilize the sample platform, anchors will not be positioned up current of the sampling point.

At each station, physical and chemical parameters, and analytical water samples will be collected from three depth strata (1 foot below the water surface, mid-depth, and one foot above the surface of the sediment). Water samples will be collected using a variable speed peristaltic pump fitted with pre-cleaned sample tubing. Physical and chemical parameters will be measured using portable field grade instruments (YSI 63, YSI 55, and HF Scientific Micro TPW). The tip of the sample tubing and instrument probes will be attached to a weighted cable and lowered to sampling depths from the boat. Data and samples will be collected during a slack tide.

At each station, the sample tubing and instrument probes (attached 1 foot above the weight) will be slowly lowered until the weight touches the surface of the sediment. Water depth, turbidity, dissolved oxygen, pH, salinity, conductivity, and water temperature will be measured and recorded. A peristaltic pump will be engaged and the water collection apparatus will be purged for two (2) minutes. The sample collection apparatus will consist of pre-cleaned Teflon and C-flex tubing attached to a 5 micron (pre-filter) and a 0.45 micron final filter. Following the system purge, a filtered water sub-sample (1/3 total volume) will be collected directly into a sample container. This process will be repeated at the two remaining sample depths to complete the filtered water sample.

The water filters will be removed from the sample tubing and an unfiltered water sub-sample (1/3 total volume) will be collected at each sample depth. A sample of unfiltered water will also be collected at each depth for total suspended solids (TSS). A clean sample collection apparatus will be used at each station.

5.8 SEDIMENT SAMPLING

Sediment sample stations will be selected in advance of the study based on investigation requirements. The objective of the station selection process will be to distribute sample stations evenly over the project area and to adequately represent all bottom types. The area includes high energy unvegetated shoreline (with and without bulkhead), and low energy sediment sumps (inside barge slips). A sample station map will be developed and the sample station coordinates will be determined before sampling is initiated.

Sampling will be conducted from a custom 20-foot aluminum boat. Sampling in the shallow Fresh Water Pond and smaller pond in the North Area will be conducted from a 14-foot aluminum skiff. Sampling in the intertidal marsh will be conducted by wading to the sample stations. A differential GPS receiver with sub-meter accuracy will be used to locate the stations and record actual coordinates, as detailed in Section 5.11. Sample station information, sample depth, and all other pertinent observations made during the study will be recorded on field data sheets.

<u>Marsh Sediment</u>

Sediment will be collected from the intertidal marsh by approaching the sample site on foot, being careful not to impact the area to be sampled. The sample will be collected using a stainless steel scoop or spoon, and will be placed in a stainless steel bowl for homogenization except for samples for VOC analyses, which will not be homogenized. Aliquots of the sample will be removed from the bowl and placed in pre-cleaned labeled sample jars. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

<u>Grab Sampler</u>

Soft surficial sediment samples from the Intracoastal Waterway, Fresh Water Pond, and Small Pond will be collected using an Ekman grab (or equivalent). The jaws of the sampler will be locked open and the sampler will be lowered to the bottom on a cable or attached to a stainless steel pole. To prevent forward wake, the sampler will not be lowered faster than 0.3 m/sec as it nears the bottom. The sampler will be retrieved slowly to ensure proper jaw closure. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment movement.

A sediment sample will be acceptable if its depth is greater than 6 inches and the surface is relatively flat and undisturbed. If a sample is not acceptable it will be set aside (do not dump overboard), and a second sample will be collected. Unacceptable samples will be discharged overboard after an acceptable sample is collected.

Prior to removing sediments from the sampler, overlying water will be drained by gently tilting it. A 0 to 6-inch sub-sample will be collected from the top of the closed sampler using a pre-cleaned spoon, scoop, or core tube. Sediment will be removed using pre-cleaned spoons and composited in pre-cleaned stainless steel bowls. Only the sediment from the center of the grab sampler (i.e., no sediment touching the walls of the sampler) will be used. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

Core Sampler

Samples of stiff sediment samples from the Intracoastal Waterway, Fresh Water Pond, and Small Pond may be collected using a piston-coring device if the grab sampler is not effective at collecting a representative sample. The coring device consists of a 3-inch diameter polycarbonate core tube attached to the end of an aluminum pole. The coring device will be manually driven into the sediment until firm resistance is detected. In the event that a single core does not provide the volume of material required by the analytical laboratory (approximately 1 liter), additional cores will be collected at that station to provide the required sediment. All cores samples from the same station will be combined and homogenized before aliquots are removed.

Sediment from 0-6 inches will be extruded into a stainless steel bowl and a sub-sample will be immediately removed with stainless steel spoon for volatile organic analysis. The remainder of the sample will then be homogenized and placed in containers for other analyses.

The empty sampler (Ekman or core) will be rinsed and decontaminated following the procedures presented in Section 5.10. The sampler and associated equipment will be decontaminated before use, and between sample sites. In addition, the sampler will be rinsed with Site water before samples are collected.

5.9 BIOLOGICAL SAMPLING

5.9.1 Fish Samples

To optimize fish capture rates, gill net placement will be timed to coincide with periods of highest fish activity (i.e., dusk to dawn). Nets will be set in the study area and background area in the late afternoon and fished through the night. To ensure that fish are removed from the nets as soon after capture as possible, the collection devices will be checked and fish will be removed once every eight hours. Fish will be removed more frequently if water temperature exceeds 28°C. As soon as individual fish specimens are removed from the collection device, they will be rinsed in ambient water to remove any foreign material. Individual specimens of the target species will be grouped by species and general-size class and placed in clean holding pans onboard the boat to prevent potential contamination. Only legal size fish will be retained for analysis.

Fish collected for this project will be examined for morphological abnormalities. The examination will consist of an assessment of four gross morphological conditions associated with pathological disorders. The characteristics that will be evaluated are:

- Fin erosion;
- Skin ulcers;
- Skeletal anomalies; and
- Neoplasms (i.e., tumors).

Although gross morphological observations generally are not definitive indicators of fish health, they may be very useful in detecting pathological conditions in fishes. The examinations will be conducted as the specimens are sorted from the catch. Sampling crew members will be trained by a qualified fish biologist to identify the various kinds of pathological conditions that may be encountered. At least two pathological conditions (fin erosion and skin ulcers) can easily be confused with the external damage that fishes may suffer after they are caught in a gill net. For all suspected abnormalities that cannot be confirmed in the field, representative specimens will be archived for later evaluation by a qualified specialist.

Specimens selected for this study will be weighed and measured, and assigned a sample number. A sample number tag will be attached to the lower jaw of each fish. After labeling, all of the fish from a sample zone will be placed together in a watertight plastic bag and sealed. The bags will be placed in an insulated cooler with ice for temporary storage and transport to the sample processing area. Plastic bags will be labeled with station ID, date, and time. Data sheets will be used to record (at a minimum) the following information:

- Gear type
- Water depth
- Set date
- Set time
- End date
- End time
- Field personnel
- Station ID
- Photo log

Additional procedures for collecting fish samples are provided in SOP-BESI-303: Collection of Finfish and Crabs Using Gill Nets (Appendix A).

5.9.2 Blue Crab Samples

Adult blue crabs (*Callinectes sapidus*) will be collected in baited commercial type crab traps (i.e., vinyl covered wire mesh). Bait will be commercial crab bait (i.e., frozen menhaden). Blue crabs captured in gill nets may also be used as samples. Traps will be placed at the selected sample sites and allowed to fish continuously until a sufficient number of crabs have been collected. Only tissue from crabs collected within a single zone will be composited. The number of crabs required to provide a minimum sample volume will depend on crab size and analytical requirements.

Immediately following collection, blue crabs will be rinsed in ambient water to remove any foreign material and inspected to ensure that their exoskeletons have not been cracked or damaged during collection. Damaged specimens will be discarded. After being rinsed, blue crab specimens will be grouped by general-size class and placed in clean holding tubs to prevent contamination.

Specimens selected for this study will be weighed and measured and assigned a sample number. Only crabs that can be legally harvested (i.e., ≥ 5 inch carapace width) will be used for this study. Both male and female blue crabs will be collected and combined for analysis. Female crabs can be legally harvested unless they are gravid. If gravid female crabs are collected during this study, they will be released and not included in the samples. All specimens collected from a zone will be sealed in a watertight plastic bag with a sample number tag, and placed in an insulated cooler with ice for transport to the processing area. Plastic bags will be labeled with station ID, date, and time. Data sheets will be used to record (at a minimum) the following information:

- Gear type
- Water depth
- Set date
- Set time
- End date
- End time
- Field personnel
- Station ID
- Photo log

Additional procedures for collecting crab samples are provided in SOP-BESI-304: Collection of Blue Crabs Using Commercial Crab Traps (Appendix A).

5.9.3 Sample Collection Requirements

The following procedures will be observed when passive collection devices (i.e., gill nets crab traps) are deployed:

- Target finfish will be removed from the passive-collection device (i.e., nets) at frequent intervals (less than 8 hours) during sample collection periods.
- Crabs captured in crab traps must be removed from the traps at an interval not to exceed 24 hours.
- All target species captured using passive collection devices will be alive at the time of removal from the sampling equipment. If they are not alive, they will be discarded.

All fish and crabs collected will be identified, counted, and logged into the field logbook. To be consistent with the convention used by most fisheries biologists in the United States, the total length of fish and carapace width of crabs selected for inclusion in the study will be measured in millimeters (*Measuring Fish Length and Wet Weight* (SOP-BESI-508) and *Measuring Crab Carapace Width and Wet Weight* (SOP-BESI-506) (Appendix A)).

Total length of a fish is defined as the length from the anterior-most part of the nose of fish to the tip of the longest caudal fin ray (when the lobes of the caudal fin are compressed dorso-ventrally). Since the caudal fin of finfish is often damaged during capture, standard length will also be measured. Standard length of a fish is defined as the length from the anterior-most part of the nose of fish to the end of the caudal peduncle (caudal tip of the spine). Carapace width of a crab is defined as the distance from the tip of lateral carapace spine to the tip of the opposite spine.

The weight in grams of finfish and crabs selected for inclusion in the study will be measured immediately after capture. Fish and crab weights will be obtained according to the appropriate SOP (*Measuring Fish Length and Wet Weight* (SOP-BESI-508), and *Measuring Crab Carapace Width and Wet Weight* (SOP-BESI-506) (Appendix A)).

A Chain of Custody document will be initiated for the samples, and the appropriate information will be recorded on both the field-log sheet and chain document, as detailed in Section 6.1.2.

Because the objective of the study is to determine the concentration of selected analytes in the edible tissues of specific fish and shellfish species, correct identification is essential. Species identification will be conducted by experienced personnel knowledgeable of the taxonomy of aquatic species in the Project area. Taxonomic keys, appropriate for the central Texas gulf coast, will be onboard the sample vessel and will be consulted if necessary.

5.9.4 <u>Tissue Processing</u>

Fish and crab samples will be processed within 24 hours of collection. Samples will be processed on-site to reduce the amount of time between fish and crab collection, and tissue removal. Removal of edible tissue will follow the procedures described in the SOPs *Fish Tissue Processing* (SOP-BESI-509), and *Crab Tissue Processing* (SOP-BESI-507) (Appendix A).

5.9.4.1 Finfish Tissue

Finfish will be weighed, measured, scaled, and rinsed with DI water. Data will be recorded on tissue processing data sheets. Once a fish has been scaled it will be placed in clean plastic bags and stored on ice until all samples have been scaled. Edible tissue filets (with skin) will be processed on pre-cleaned Teflon cutting boards with pre-cleaned stainless steel filet knives. EPA Guidance (EPA, 2000) recommends that the fillets of scaled finfish (e.g., red drum, black drum, croaker, seatrout, etc.) be analyzed with the skin intact. Edible filets will be collected from both sides of the fish, placed on hexane-rinsed aluminum foil, and weighed in grams. The filets will be double wrapped in hexane-rinsed aluminum foil.

Most fish samples will be taken from a single specimen, but if a single fish can not provide the required sample volume, the fillets from multiple fish will be composited. If more than one organism is to be composited to complete a sample, the individual organisms will be filleted, filets will be weighed, and the filets will be combined and double wrapped in hexane-rinsed aluminum foil.

Foil wrapped filet samples will be placed in a Ziploc bag labeled with collection date, time, personnel, species, and station ID. The sample will then be placed in another Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed following the procedures detailed in Section 6.1.2.

5.9.4.2 Blue Crab Tissue

Blue crabs will be weighed, measured, rinsed with DI water, and placed on pre-cleaned Teflon cutting boards. Data will be recorded on tissue processing data sheets. Edible blue crab tissue (i.e., muscles inside chelipeds and musculature for periopods) will be removed using pre-cleaned scalpels and placed on hexane rinsed aluminum foil for weighing.

In order to provide the analytical laboratory with a sufficient quantity of tissue for all analyses, the edible tissue from five adult blue crabs from the same zone will be composited for each sample. The weight of edible tissue will be recorded for each individual crab and for the total edible tissue per sample. A pre-cleaned sample jar will be labeled with the collection date, time, personnel, species, and station ID.

Sealed samples will be placed in a Ziploc bag labeled with collection date, time, personnel, species, and station ID. The sample will then be placed in another Ziploc bag and stored at 4 degrees Celsius. A Chain of Custody will be completed for all samples collected.

5.10 DECONTAMINATION PROCEDURES

Site personnel will perform decontamination in accordance with PBW SOP No.13: Equipment Decontamination (Appendix A) will be performed for all equipment when brought on the Site, between sample locations, when necessary between sample intervals, and before removing it from the Site. Certain disposal equipment meant to be used only once and discarded will be decontaminated prior to use, unless the equipment is properly packaged and sealed. All non-disposable components of the sampling equipment that will not have direct contact with the samples collected (i.e., augers, probe rods, drill pipe, etc.) will be decontaminated as follows:

- Potable water rinse;
- Liqui-nox® detergent wash;
- Potable water rinse;
- De-ionized (DI) water rinse (3 times); and
- Air dry.

All sampling equipment that contacts the soils, groundwater, sediments, or surface waters that will be submitted for analyses (i.e. coring equipment, compositing bowls, scoops and spoons) will be decontaminated as follows:

- Potable water rinse;
- Liqui-nox® detergent wash;
- DI water rinse;
- Liqui-nox® detergent wash;
- DI water rinse (3 times); and
- Air dry.

A methanol or hexane rinse may be used if evidence of organic staining is found after equipment has been cleaned. Equipment rinsate blank samples will be collected as specified in the QAPP to document the effectiveness of decontamination. Following decontamination, the sampling equipment will be placed in bags or sealed to keep the equipment clean during storage.

All liquids generated as a result of decontamination processes will be containerized and handled as IDW as detailed in Section 7.0.

5.11 SURVEYING

Following completion of field activities, a licensed surveyor will survey the horizontal coordinates and vertical elevations of the monitoring wells and the staff gauges with a vertical accuracy of 0.01 feet at each sampling location. Other sampling stations (soil borings, surface water sampling stations, sediment stations, and fish tissue sampling stations) will be surveyed in the field with the differential GPS meter. Since the temporary piezometers will be installed for a short period of time (about 48 hours), the ground surface adjacent to the temporary piezometers will be surveyed. The top of casing elevation for the piezometers will be calculated based on the ground elevation and the height of the temporary casing above the ground surface. All horizontal coordinates will be referenced to the Texas State Plane Coordinate System, North American Datum from 1983, and elevations will be surveyed relative to the National Geodetic Vertical Datum of 1988.

6.0 SAMPLE HANDLING AND ANALYSIS

6.1 SAMPLE HANDLING

To prevent misidentification of samples, labels will be affixed to each sample container. Information will be written on the label with a permanent marker. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- Project identification number;
- Sampling station identification name;
- Name or initials of collector;
- Date and time of collection;
- Analysis required (if space on label allows); and
- Preservative inside bottle, if applicable.

Sample aliquots will be containerized in order of decreasing analyte volatility. Sample containers will be filled in the following sequence: VOCs; extractable organics (including SVOCs and PCBs); pesticides; and then metals and other analyses.

Samples will be placed in shipping coolers containing bagged, cubed ice immediately following collection. The samples will be grouped in the shipping cooler by the order in which the samples are collected. Samples will be shipped to the laboratory via an overnight courier service, generally on the day they are collected. The only exceptions to this procedure will be for samples collected after the courier service has picked up the shipment for the day and samples collected on a Sunday or holiday. In these instances, the samples will be shipped on the next business day. Specific protocols are included in PBW SOP-6: Sample Custody, Packaging and Shipment (Appendix A).

6.1.1 Sample Preservation

Appendices A through D in the QAPP identifies the requirements for the number of containers, container volume, container type (material of construction), preservation, and holding time periods for each of the analytical methods.

6.1.2 Sample Chain-Of-Custody Forms and Custody Seals

Evidence of collection, shipment, and laboratory receipt must be documented on a Chain-of-Custody record by the signature of the individuals collecting, shipping and receiving each sample. A sample is considered in custody if it is:

- In a person's actual possession;
- In view, after being in physical possession;
- Sealed so that no one can tamper with it, after having been in physical custody; and/or
- In a secured area restricted to authorized personnel.

Chain-of-Custody Records will be used, by all personnel, to record the collection and shipment of all samples. The Chain-of-Custody Record may specify the analyses to be performed and should contain at least the following information:

- Name and address of originating location of samples;
- Name of laboratory where samples are sent;
- Any pertinent directions/instructions to laboratory;
- Sample type (e.g., aqueous);
- Listing of all sample bottles, size, identification, collection date and time, and preservative, if any, and type of analysis to be performed by the laboratory;
- Sample ID;
- Date and time of sample collection; and
- Signature of collector as relinquishing, with date/time.

The Chain-of-Custody procedure will be as follows:

1) The field technician collecting the sample shall be responsible for initiating the Chain-of-Custody Record. The names of all members of the sampling team will be listed on the Chain-of-Custody Record. Samples can be grouped for shipment on a common form.

2) Each time responsibility for custody of the samples changes, the receiving and relinquishing custodians will sign the record and note the date and time.

3) The Chain-of-Custody Record shall be sealed in a watertight container, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier. The carrier waybill shall serve as an extension of the Chain-of-Custody Record between the final field custodian and receipt in the laboratory. The commercial carrier is not considered part of the COC chain and is not required to sign the COC.

4) Upon receipt in the laboratory, a designated individual shall open the shipping containers, measure and record cooler temperature, compare the contents with the Chain-of-Custody Record, and sign and date the record. Any discrepancies shall be noted on the Chain-of-Custody Record.

5) If discrepancies occur, the samples in question shall be segregated from normal sample storage and the project manager will be notified for clarification.

6) Chain-of-Custody Records, including waybills, if any, shall be maintained as part of the project records.

6.2 SAMPLE ANALYSIS

As presented on Table 5, samples with be analyzed using the analytical methods listed for each media. Following the EPA guidance document titled “Guidance for Data Usability in Risk Assessment” (EPA, 1991), Method Selection Worksheets were prepared for soil, groundwater, surface water, and sediment as provided in Appendix B as Tables B-1 through B-4, respectively. The tables list the COIs that will be analyzed for each media sampled, with the exception of fish tissue. The COIs for fish tissue will be established following the sediment sampling of the Intracoastal Waterway as detailed in the RI/FS Work Plan. The tables also list the PSVs, as defined in the RI/FS Work Plan, for each COI with the required method detection limits.

6.3 FIELD DOCUMENTATION

Field data will be recorded on standard forms (e.g., stratigraphic logs), as detailed in PBW SOP No. 1 – Field Documentation. Field data primarily will be direct observations, hand measurements, direct-readings from field meters. These data will be tabulated and included in project reports or submittals, as appropriate. Appropriate field forms will be used to record field data collection activities.

Entries will be described in as much detail as possible to ensure that a particular situation could be reconstructed only from field entries. Entries will include the date, start time, weather, names of all sampling team members present, and the signature of the person making the entry will be entered. The names of individuals visiting the site or field sampling team and the purpose of their visit will also be recorded. All field measurements obtained and samples collected will be recorded on the appropriate forms. All entries will be made in ink, signed and dated. If an incorrect entry is made, the incorrect information will be crossed out with a single strike mark that is initialed and dated by the person making the erroneous entry. The correct information will be entered adjacent to the original entry.

Whenever a sample is collected or a measurement is made, a detailed description of the location will be recorded on the appropriate form. Photographs taken at a location, if any, will also be noted in the daily field form. All equipment used to obtain field measurement as well as the field calibration data will be recorded on the appropriate field forms.

Samples will be collected following the sampling procedures documented in this FSP. The equipment used to collect samples, time of sample collection, sample description, volume and number of containers, preservatives added (if applicable) will be recorded on the appropriate field forms. The field forms will be filed in the PBW Office project files.

7.0 MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

IDW generated from borings or monitoring wells will be placed in Department of Transportation (DOT)-approved drums and managed for off-site disposal. These wastes will be characterized following the RI activities. The IDW will then be classified based on the analytical results and disposed of accordingly. An area at the Site will be designated by the Field Supervisor for the staging of drums awaiting characterization and disposal. Management of IDW is further described in PBW SOP No. 14: Storage and Disposal of Soil, Drilling Fluid, and Water Generated During Field Work (Appendix A). The following general parameters will be followed to characterize the IDW at the Site:

- Use process knowledge and data from environmental media samples to assist in the evaluation and classification of IDW, where possible (e.g., groundwater sample data can be used to evaluate classification of well development and purge water).
- Collect composite samples from specific IDW waste streams, where environmental media data are not available (e.g., water collected after decontamination of drilling equipment).
- Analyze each sampled IDW waste stream in accordance with applicable state and federal regulations, and in accordance with any facility-specific requirements of potential waste management (recycling/disposal) facilities.

Upon completion of RI activities, the IDW will be transported to appropriate off-site waste management facilities or otherwise managed in accordance with all applicable state and federal regulations. All records documenting the IDW characteristics, waste classifications, quantities, final management locations, and waste manifest forms will be filed in the project files.

8.0 FIELD HEALTH AND SAFETY PROCEDURES

The overall health and safety objective is to perform the field tasks in a manner that minimizes the potential for accidents or injuries, and minimizes the potential for worker exposure to hazardous chemicals. Details of the health and safety procedures are provided in the Site-Specific Health and Safety Plan (HSP) (PBW, 2005), dated August 17, 2005.

The HSP applies to the field activities described in this FSP that will be performed during the RI/FS at the Site. The HSP was prepared to comply with the requirements of 29 CFR 1910.120 (b)(4). The primary purpose of the plan is to provide the results of a hazard assessment conducted for the prescribed work tasks, and the health and safety requirements and protocols that will minimize hazards to site workers.

A copy of the HSP will be kept on site at all times during field activities. All personnel will complete the Safety Compliance Agreement provided in Appendix A of the HSP. Other health and safety documentation are detailed in the HASP.

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TABLES

FIGURES

APPENDICES

APPENDIX A
STANDARD OPERATING PROCEDURES

APPENDIX B
METHOD SELECTION WORKSHEETS